Attachment 9 – Economic Analysis – Flood Damage Reduction Costs and Benefits

The CID South and Highland Project (Project 1) will provide flood damage reduction benefits. The findings in IRWMP Section 7.2 – Floodplain and Stormwater Management, include the use of multi-purpose facilities to provide increased flood protection and farmland protection. The IRWMP specifically seeks to encourage flood control and stormwater management at multi-use (Regional Conjunctive Use) facilities such as the CID Project. The development of basins for this purpose has been initiated by the region and this project is one of the proposed projects that seek to provide flood protection and improve use of stormwater conjunctively.

The 53-acres of ponding basin will provide additional storage volume for diversion of water flood flow waters from the Kings River. In major flood events, water will be diverted from the Kings River into CID's system and diverted to the basin. Having additional storage volume.

Project Description and Costs
The CID project will develop a 75-acre site with more than 53 acres of ponding basin that will have as much as 5 feet of storage. Improvements included in the project will provide more than 160 acre feet of surface storage and allow for a diversion capacity of 50 cfs into the basin. The cost of the basin and detailed supporting information are included in Attachment 4. The annual costs are included in Table 11 also included in Attachment 4. Table 17 was not completed as the same information is provided in Table 11.

Flood Damage Benefits
The proposed basin will have an instantaneous capacity of approximately 160AF assuming only 3 feet of water in the 53 acres of basins. This assumed maintaining 1-2 feet of freeboard within the basin at all times. Actual storage volume is greater, but for purposes of the proposed benefit calculation this is a conservative assumption. With infiltration, the volume available for storage is actually greater, but for the purposes of this estimation, only the instantaneous, or standing volume, was assumed. The assumed flood damage reduction is based on the surface storage volume of the basin and the idea that the amount of water that the CID basin can store would not be in a channel to break and cause inundation of property. Without the project, there would be approximately 160AF less storage on the system. With the project, the volume of water that could cause damage is reduced by the 160AF of floodwater that is diverted and stored at the basin.

Assuming flood damage occurs when the flood depth is 2 feet, the project will provide protection for 80 acres of farmland. If the flooding were to occur in more developed or urban areas, the damage would likely be greater, but for a conservative estimate, a farmland property is assumed. Assuming the area inundated is a table grape vineyard common to the area, one

acre produces approximately 9 tons at a value of $1,528/ton (County of Fresno Department of Agriculture 2009 Crop Report, http://www.co.fresno.ca.us/DepartmentPage.aspx?id=33743). That equates to $13,752/acre or $1,100,160 for the 80 acres that we have protected.

Flood damage reduction benefits for this basin project could also be estimated based on the instantaneous flow diversion capability. The basin will have a diversion capacity of 50cfs. With maximum flows in excess of 4,000cfs along portions of the Kings River downstream of the CID turnout, an increase in storage for the instantaneous flow of 50cfs (or sustaining flow of 10cfs if the basin was near full) could be taken as a percentage of the overall flow in the channel downstream. Diversion of this additional flow would reduce the flow downstream by a certain percentage, thereby reducing the downstream threat by some percentage. However, that relationship is not linear, and will likely overestimate the value of the flood damage reduction benefits. For that reason, the more conservative estimation of the flood damage reduction benefits was to equate the total surface storage volume of the basin and the potential amount of area that could have been flooded by that area.

As a conservative estimation of the overall project benefits and because the flood damage reduction benefits are considered secondary to the water supply benefits, the cost benefit for flood damage reduction was not included in Table 20.

Background and Supporting Information

The region has a history of flood problems downstream of CID's turnout. The floods flows of 1969, 1983, 1995 and 1997 caused flood damage within the region. Agricultural lands were inundated, and lands outside the project levees of the channel were adversely affected by seepage. As supporting information for the frequency of the events, below is a listing of some of the recent levee breaches and associated repair costs.

1. **April 1995** During flood releases, a 15-foot section of bank breached. Floodwaters spread over approximately 1,300 acres of farmland and caused damage to some homes and buildings. At the time the levee failed, flows in the river below Crescent Weir were approximately 4,000 cfs. The design flood flow through this section is 4,750 cfs. Improvements and damage totaled $391,359.00.

2. **August 1997** Up until 1997, during periods of flood releases the levees were substantially weekend because of the tremendous amount of seepage along the landside toe. Improvements and damage totaled $765,517.

3. **April 1998** During flood releases of 2,500 to 4,250 cfs, seepage increased along the landside project levee immediately downstream of Bryant Ave, causing landside sloughing, and the presence of sand boils. Improvements alone totaled $72,000.

4. **May 1998** During flood releases of 4,250 cfs to 4,750 cfs, waterside sloughing increased immediately downstream of Bryan Avenue. Improvements alone totaled $ 90,000.

Other Flood Damage Reduction Benefits

Project 2 – City of Clovis SWTP Expansion

The City of Clovis SWTP Expansion (Project 2) may also provide some flood damage reduction. The Clovis SWTP receives surface water for treatment from the Enterprise Canal. The Enterprise Canal receives sheetflow runoff water to the east and upstream of the SWTF, as well as controlled diversions from eastside creeks into the Enterprise Canal. Downstream of the SWTP there are known capacity constraints as noted in the 2002 Enterprise Canal and Capacity Study. Project 2 will expand the treatment capacity of the SWTP, allowing more water to be conveyed into the SWTP from the Enterprise Canal. During a flooding event, this could reduce the amount of water that is directed downstream to the known capacity concern areas. However, if the turbidity of the water is too high, the City cannot treat the water. Although the City can operate with moderate turbidity and has in previous flood events, there are too many variables to estimate the amount or frequency that the City can take the floodwater in the SWTP. For this reason, a cost estimate of the benefits were not included.

Project 3 – Drummond Jensen Avenue Sewer Feasibility Study

Although this project is a feasibility study and not a flood damage reduction project, flooding in the area where there is seepage pits can saturate conditions causing backup problems or accelerating nitrate movement to groundwater. If constructed as a result of the feasibility study, it is possible that flooding in the area will not cause increased damage to groundwater conditions. No benefit is being claimed for this in the application.

Table 18 - Event Damage

Proposal: Groundwater Overdraft Reduction and Disadvantaged Community Water Supply Reliability Projects
(2009 Dollars)

Hydrologic Event	Event Probability	Flood Damage Estimation	Probability Structural Failure		Event Damage		Event Benefit (Million $)
			Without Project	With Project	Without Project	With Project	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
					(c) x (d)	(c) x (e)	(f) – (g)
10-Year	0.1	$0	0.5	0	$0	$0.00	$0
15-Year	0.067	$0	0.75	0	$0	$0.00	$0
20-Year	0.05	$0	1	0	$0	$0.00	$0
25-Year	0.04	$1,100,060	1	0	$1,100,060	$0	$1,100,060
50-Year	0.02	$1,100,060	1	0	$1,100,060	$0	$1,100,060